Preliminary Design and Prototyping Results of an Encapsulated Underwater Launch System for Micro Unmanned Aerial Vehicles (UAVs)

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AGENDA

SPAWAR Systems Center San Diego

- Introduction to SPAWAR Systems Center
- Introduction to WaterWorks
- System Properties
- Field Test Results
- Problem Solving & Optimization
- Future Work
- Conclusions

POINT LOMA PENINSULA
HOME OF SPAWAR SYSTEMS CENTER (SSC) SAN DIEGO

SPAWAR Systems Center San Diego

4000 Employees

Leader in C4ISR

$1.7B / yr business

At any time, the Center has approximately 1500 active programs!

SSC SAN DIEGO – ISR – OCEAN SYSTEMS DIVISION

SPAWAR Systems Center San Diego

- Test & Evaluation
- Fleet Support
- Undersea Vehicles/ Robotics
- Undersea Search & Work Systems
- Radiation Detection
- Undersea Materials
- Fiber Optics
- Undersea Communications
- Electro Optics
- Acoustic Warning Systems
- Targets
- Rapid Prototyping
- Diving






SSC SAN DIEGO – OPEN OCEAN UNDERSEA ROBOTICS

SPAWAR
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ROVs

AUVs

Launch &
Recovery

UNMANNED SYSTEMS TEST ENVIRONMENT

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San Diego

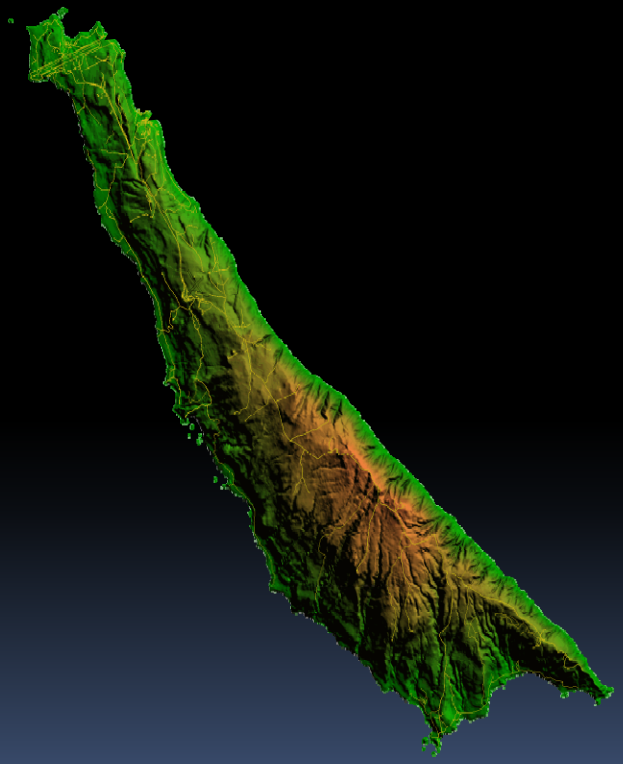
- Proximity to Fleet and Operational Commands
- Ocean Access
  - Shallow
  - Very Deep
- Paved & Unpaved Roads
- Off Road Terrain
- Bunkers & Tunnels
- UAV flight ops area

Miles of Coastline for Unmanned Systems RDT&E and experimentation

OTHER SUPPORTING FACILITIES

SPAWAR
Systems Center
San Diego

San Clemente Island



TRANSDEC

ALL AREAS OF THE BATTLESPACE

SPAWAR
Systems Center
San Diego

WATERWORKS

SPAWAR Systems Center San Diego

A new innovations cell at SPAWAR Systems Center San Diego designed to react rapidly to warfighter needs

Vision:

Systematically innovate and transition prototypes to rapidly create solutions that solve latent unmet warfighter needs.

The Waterworks team demonstrated its capabilities by designing, fabricating, testing, and improving an underwater launch system for an unmanned aerial vehicle.

WATERWORKS
UNMANNED SYSTEMS INNOVATION

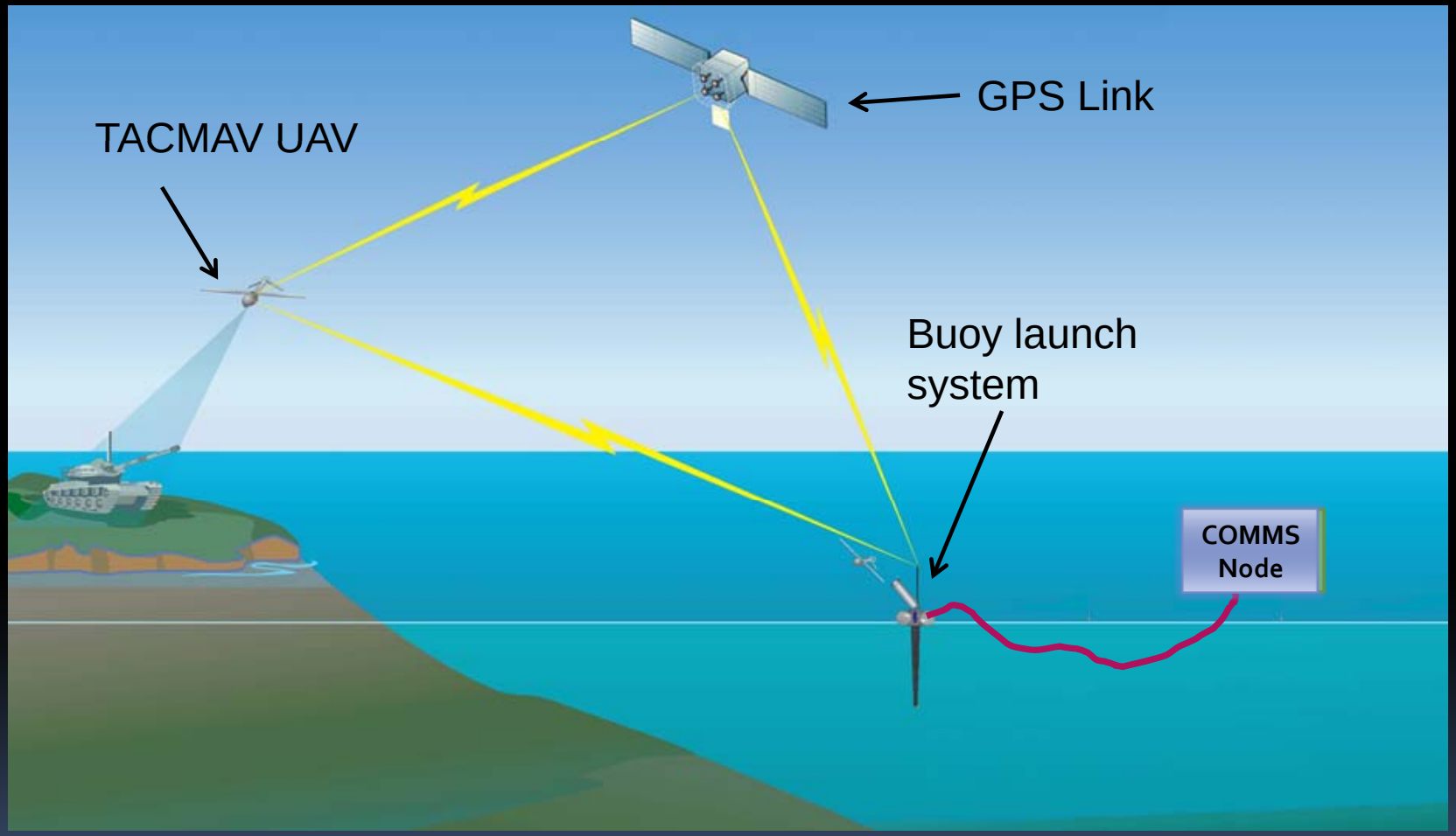
WATERWORKS GOALS

SPAWAR Systems Center San Diego

- Develop *game-changing* solutions for warfighters
- Systematic innovation through methodology, culture, and infrastructure
- Create pockets of Innovation that can be replicated across the center
- Create and strengthen ties among warfare centers, industry and international partners

SYSTEM OVERVIEW

SPAWAR Systems Center San Diego



SYSTEM PROPERTIES

SPAWAR
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TACMAV Properties

TACMAV Surveillance Video

Buoy Launch Hardware Properties

Communications Setup

Host Platforms

TACMAV PROPERTIES

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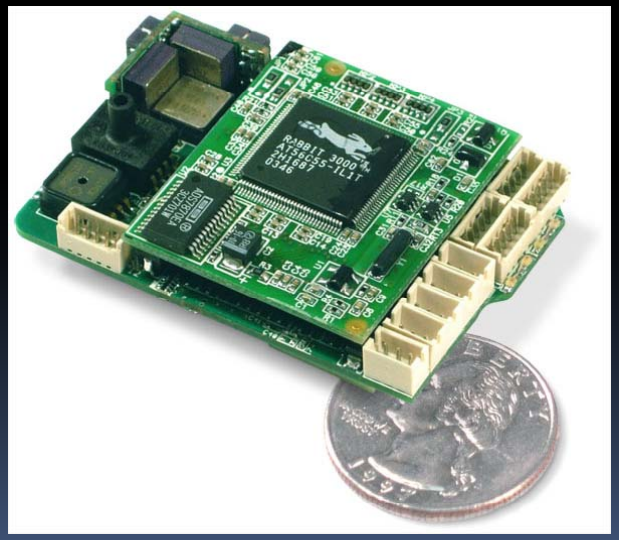

TACMAV FLIGHT VIDEO

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BUOY LAUNCH HARDWARE

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- Compacted

- Deployed

COMMUNICATIONS SETUP

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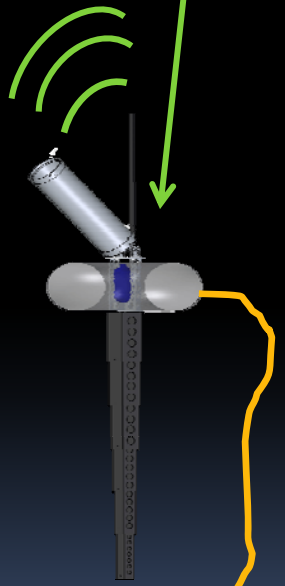
TACMAV with
RF Modem

Buoy with RF Modem

Communications Cable



Laptop running
Buoy Launch software
and UAV C2

HOST PLATFORMS

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UNMANNED UNDERWATER VEHICLE

DIVER

HUMVEE

Technology developed can be applied to many platforms

PROTOYPE & TEST TIMELINE

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Stage 1: Initial Trials

- Nov 2006
- Tube-launched UAV on land with R/C gear
- Hand launched UAV tests with autopilot system

Stage 2: Prototype Development

- Jan - March 2007
- Hardware designed and built
- Software written, integrated, and tested

Stage 3: Demonstration

- April 2007
- Tests were performed at TRANSDEC & San Clemente Island
- System issues were identified

Stage 4: Debugging

- May 2007 – Dec 2007
- System issues were debugged and some changes to the system
- Future Work was identified

150 Days , 90% of entire effort

FIRST UAV FLIGHT

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FIRST UAV FLIGHTS WITH KESTREL AUTOPILOT

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UAV FLIGHT WITH AUTOPILOT AT TRANSDEC

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SAN CLEMENTE ISLAND DEMO

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EXAMPLE VIDEO ANALYSIS

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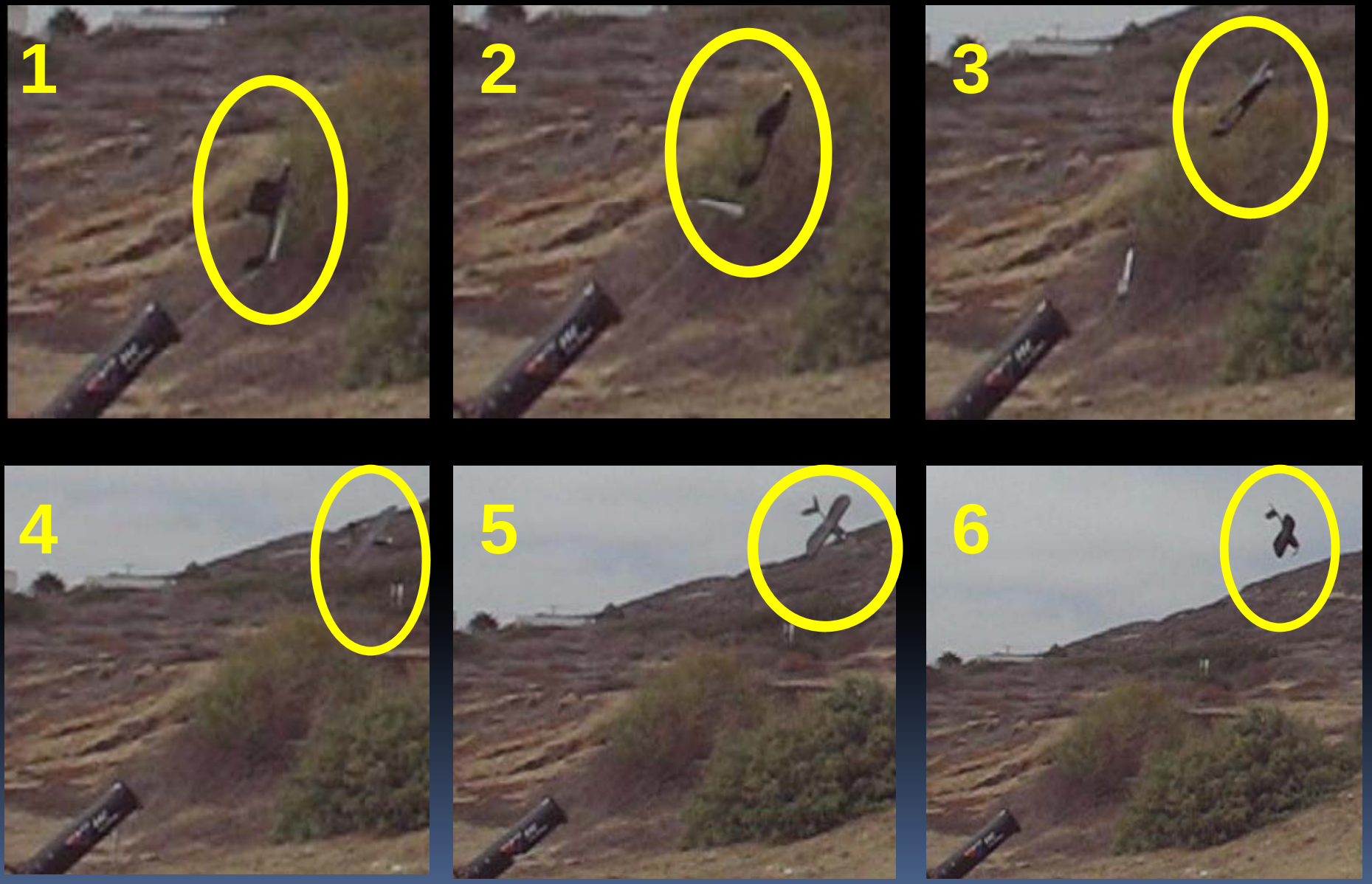

EXAMPLE SENSOR DATA

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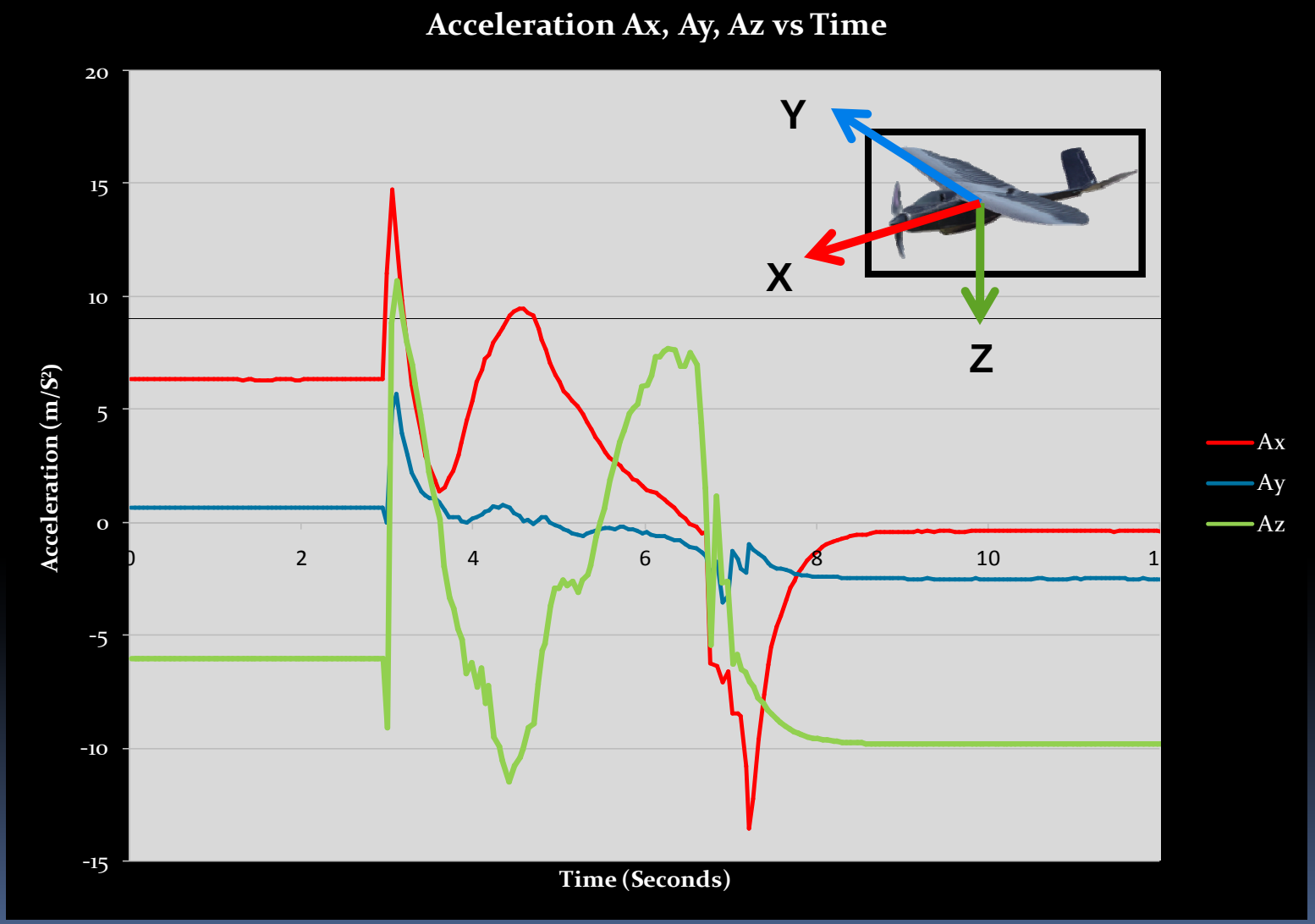

FLIGHTS AFTER MECHANICAL CHANGES

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SUCCESSFUL FLIGHT IN AUTONOMOUS MODE

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FUTURE WORK

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- Demonstration of a reliable system from seafloor deployment of buoy to UAV launching from the surface of the ocean
- Prototype development of a linear track type scheme to launch the UAV with a vertical buoy configuration
- Optimization of the autopilot software code for a better fit to our platform configuration
- More fully autonomous flights to gauge the reliability of TTF with the current system configuration
- Investigations on tactical advantages of ARA's new Nighthawk UAV or other manufacturer's UAV systems

CONCLUSIONS

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- The Waterworks team successfully demonstrated unmanned systems innovation by designing, developing, testing, and improving an underwater launch platform for a UAV. This was accomplished in a short time frame.
- Waterworks is committed to improving the UAV launch system configuration features for a more robust warfighter solution that can be tailored to specific uses
- The Waterworks process has been used by various projects at the center
- This innovation effort has been a great opportunity to collaborate with many expert scientists, engineers, and personnel across the SSC Divisions, warfare centers, and industry. We are very interested in teaming with coalition partners as we continue our unmanned systems work.